Assessment

System Timing Thread
Atlas DP1

Checkout and Launch Control System (CLCS)

84K00303-020

Approval:

Chief, Hardware Design Division	Date	Chief, System Engineering and Integration Division	Date
Chief, Software Design Division	Date	CLCS Project Controls Office	Date
Chief, System Applications Division	Date	Project Manager, CLCS	Date

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Supporting Document Note:

Acronyms and definitions of many common CLCS terms may be found in the following documents: CLCS Acronyms 84K00240 and CLCS Project Glossary 84K00250.

REVISION HISTORY

REV	DESCRIPTION	DATE
Basic	Promoted per approval by Design Panel. Updated to standard format. ljp	5/22/98

LIST OF EFFECTIVE PAGES				
Dates of issue of change pages are:				
Page No.	**A or D***	**Issue or Change No.**	**CR No.**	**Effective Date****

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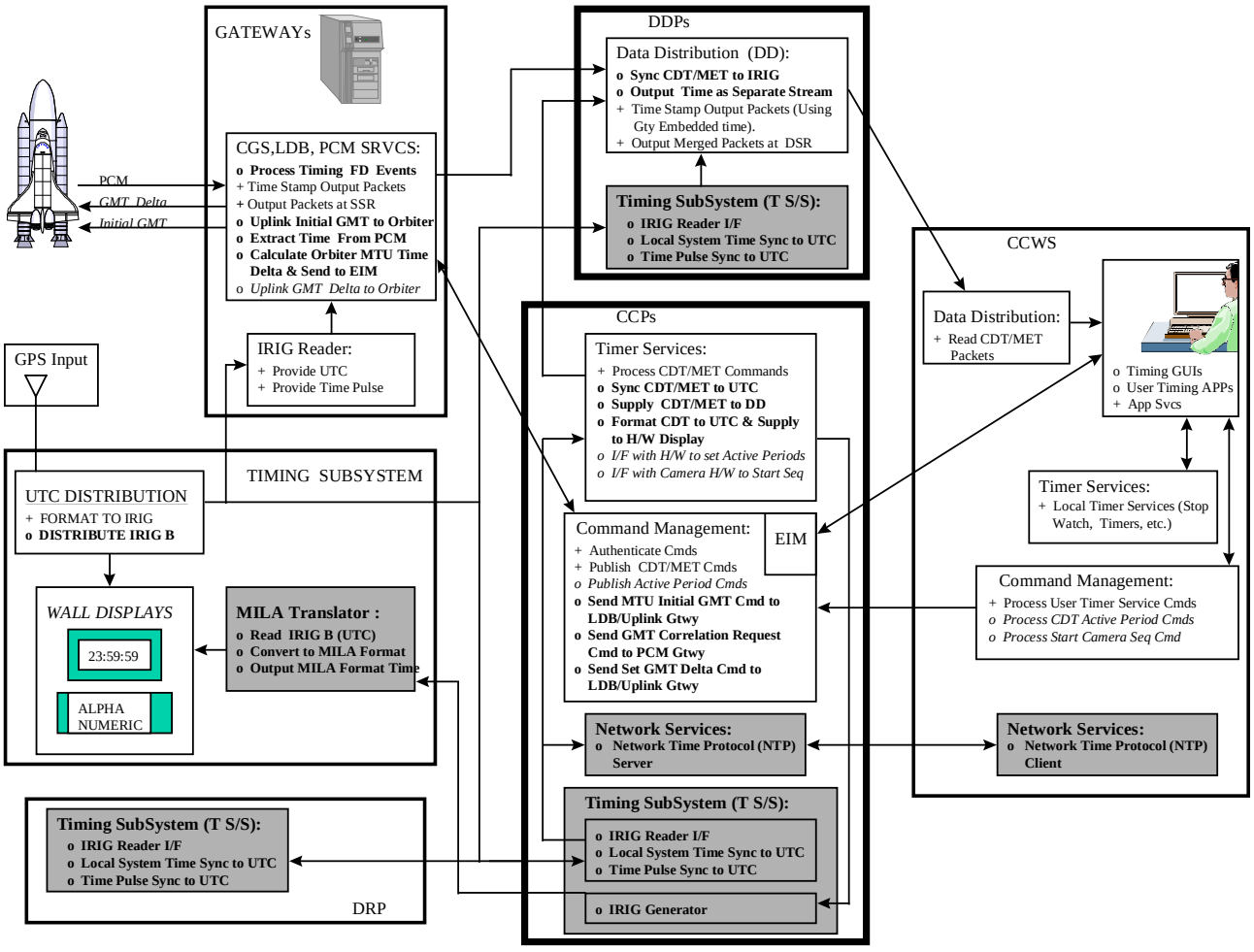
The matrix above is used to identify the members of the assessment team.

1. INTRODUCTION

1.1 SYSTEM TIMING THREAD OVERVIEW.

This thread provides the distribution of Universal Coordinated Time (UTC) for display, data time stamping, and synchronization of other derived times and application timers. Count Down Time (CDT), Mission Elapsed Time (MET) and their Active Periods (also referred as time remaining) will be generated, managed and distributed. In addition, this thread provides the capability for synchronizing the Orbiter's Master Timing Unit (MTU) to the GMT.

1.2 SYSTEM TIMING THREAD CONCEPT



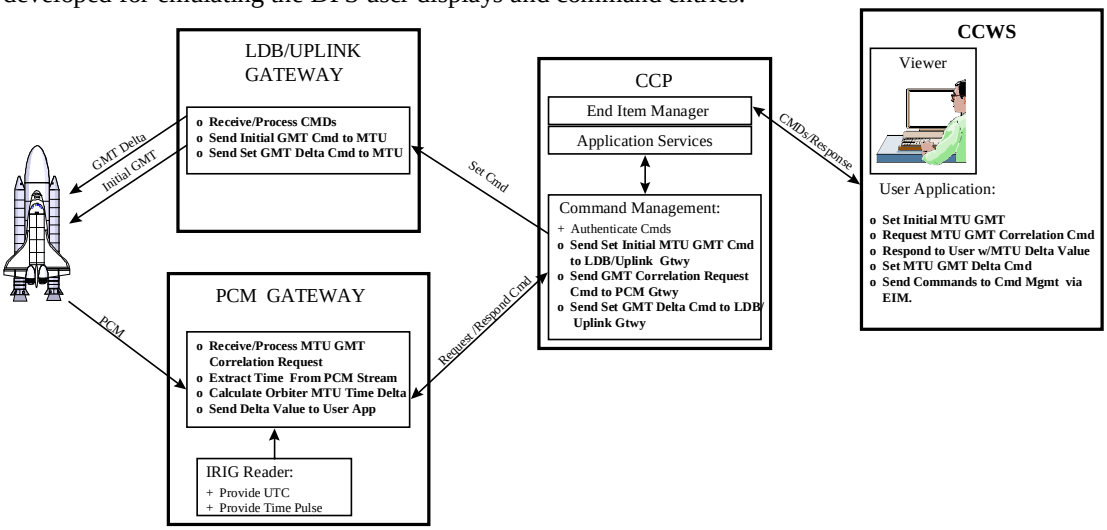
Nomenclature: + = Completed in earlier deliveries
Bold = To be done in this Atlas Delivery
Italics = To be done in a future delivery

SYSTEM TIMING DESIGN CONCEPT DIAGRAM

Universal Coordinated Time (UTC). For Atlas, the existing KSC Launch Status Clock System will acquire the Universal Coordinated Time from the Global Positioning System and distribute to designated CLCS facilities (SDEs, IDE, HMF, SAIL,etc.). The Gateways, DDPs, CCPs, and DRPs will each contain an IRIG I/F Card for input of the IRIG B time which will provide local UTC and time pulses (or interrupts) for process synchronization. The COTS Network Timing Protocol (NTP) server process in the CCP will distribute the local UTC to the CCWS NTP clients.
Count Down Time (CDT). An initial CDT and MET capability was provided in Thor by the Timer Services CSC. The CDT was distributed by Data Distribution to the CCWS applications using the gateway SSR data stream as the clock source for outputting the data. In Atlas, the CDT will be synchronized with the IRIG B provided by the interface card and Data Distribution will output the packet as a separate stream - independent of the Gateway data. Timer Services will also be responsible for providing the CDT in Merritt Island Launch Area (MILA) Format as required by the Wall Clocks. The details for interfacing to the MILA time code generator is still TBD and will be resolved by the DP2 timeframe.
Active Periods (time remaining clocks). The current LPS wall displays are manually set and require relay switch activation for initiating the count (e.g. Count/Hold Remaining, APU Run Time, etc.). In addition these wall clocks are identified by manually placing labels underneath the displays. For Atlas, a Systems Engineering evaluation and proposed solution for enhancing this function will be conducted. The hardware and software required to support this capability will be identified for implementation post Atlas.
High Speed Camera Sequencer. A command will be sent to the High Speed Camera Sequencer at the T-3 minutes 3 Second point in the countdown and is controlled by the Count/Hold commands after the start command is initiated. This capability will be provided post Atlas.
GMT Correlation. The PCM Gateway, upon receiving a Time Correlation Request from a User Application EIM, will read the embedded MTU time in the PCM stream and calculate the MTU to GMT delta. The computed delta values will be sent as a response to the User Application which in turn will send to the LDB Gateway a DEU E command for uplink to the Orbiter.

1.3 OPERATIONAL AND FUNCTIONAL OVERVIEW

GMT Correlation. Upon Orbiter Power-up the initial GMT values are entered via a ground Display Electronic Unit (DEU) set of commands. The time might not be accurate and will therefore require adjustments by executing several GMT Correlation Commands by the DPS console. The **key** ingredient of this function is accuracy. Once the PCM Gateway receives the C-to-C Request Command to start the GMT Correlation, it must extract the Orbiter embedded time from the PCM stream. It will then use local timers, which are synchronized to IRIG B, to determine the time difference. A known value for the bus transmission delay and software execution delay are appended to derive at a final time delta. A C-to-C response with the delta value is sent back to the DPS console who in turn sends the command to the LDB Gateway for uplink to the Orbiter. This process can be repeated several times until the desired accuracy is obtained. Special equipment will be required in order to derive the transmission time delays (unless they remain the same) and for testing the Orbiter commands. Resolution of these two items is TBD. For Atlas, test software will be developed for emulating the DPS user displays and command entries.



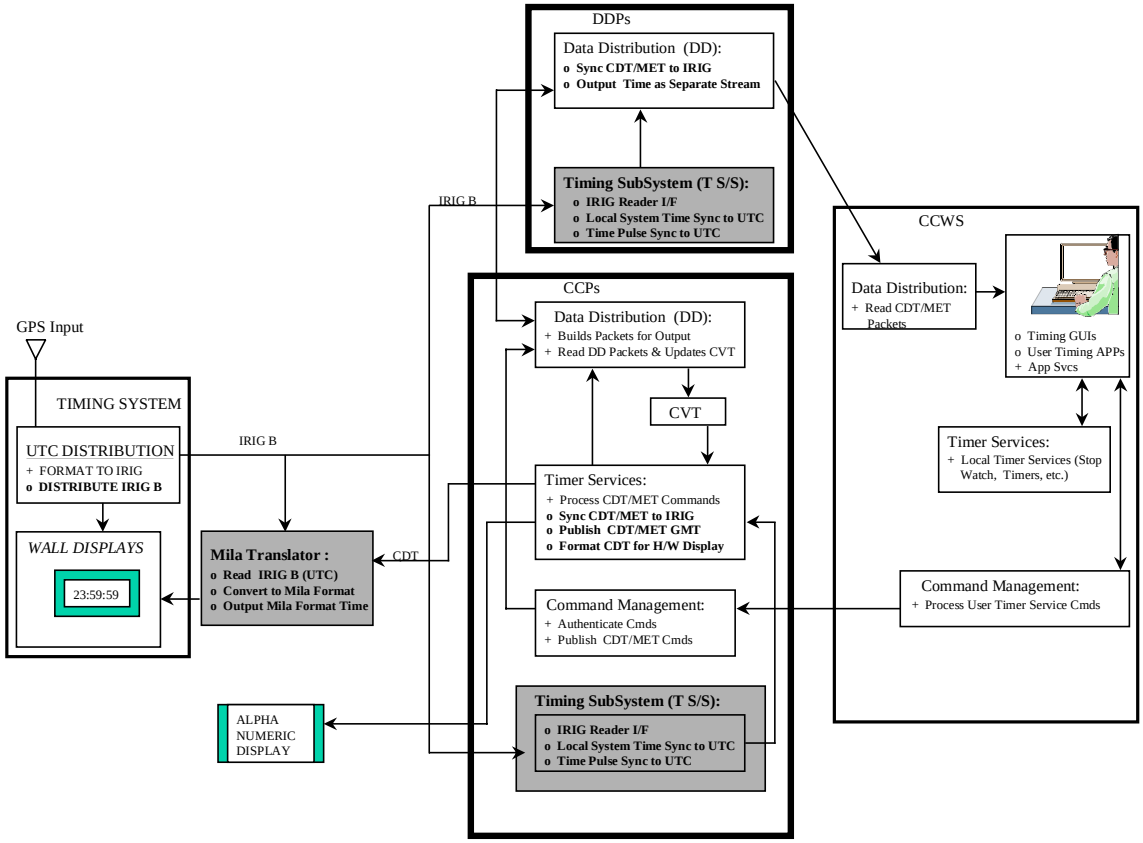
GMT CORRELATION OPERATIONAL CONCEPT DIAGRAM

Count Down Time. The Count Down Time (CDT) is distributed in two forms. One as a Data Distribution packet for use by the CCWS applications and the other in MILA format for Wall Clock Displays located in various KSC facilities. During Launch support, there can only be one controlled area which will be responsible for setting the CDT. As an example, OCR1 might be supporting the mission and OCR2 configured in monitor mode. The CDT across all KSC facilities would be driven by the OCR1 command entries. Development environments (SDEs, IDEs, etc.) are exceptions as they will have their own displays, test tools and/or simulators.

Data Distribution Packet: In Thor, the Timer Services CSCI provided an initial CDT capability. The user entries of CDT and associated time commands (e.g. Hold, Count, etc.) are received by the local CCWS Command Management for authentication and transferring the packet, using IPC, to the Command Management at the CCP. The time commands received by Command Management at the CCP, are authenticated, and published as pseudo FDs. These FDs are treated by Data Distribution as any other FD at the DDP and are transferred back to the CCP where the CVT is updated due to a state change. Timer Services reads the CVT and acts on the changed entry. For Atlas the Central Timer Services will change from synchronizing the CDT using a software interrupt, as in Thor, and will use IRIG I/F hardware interrupt instead. Data Distribution will also use its local IRIG B as its clock source for distributing the time data onto the RTCN and DCN. **The CDT time data should not be associated or rely on the Gateway change data streams for its distribution**.

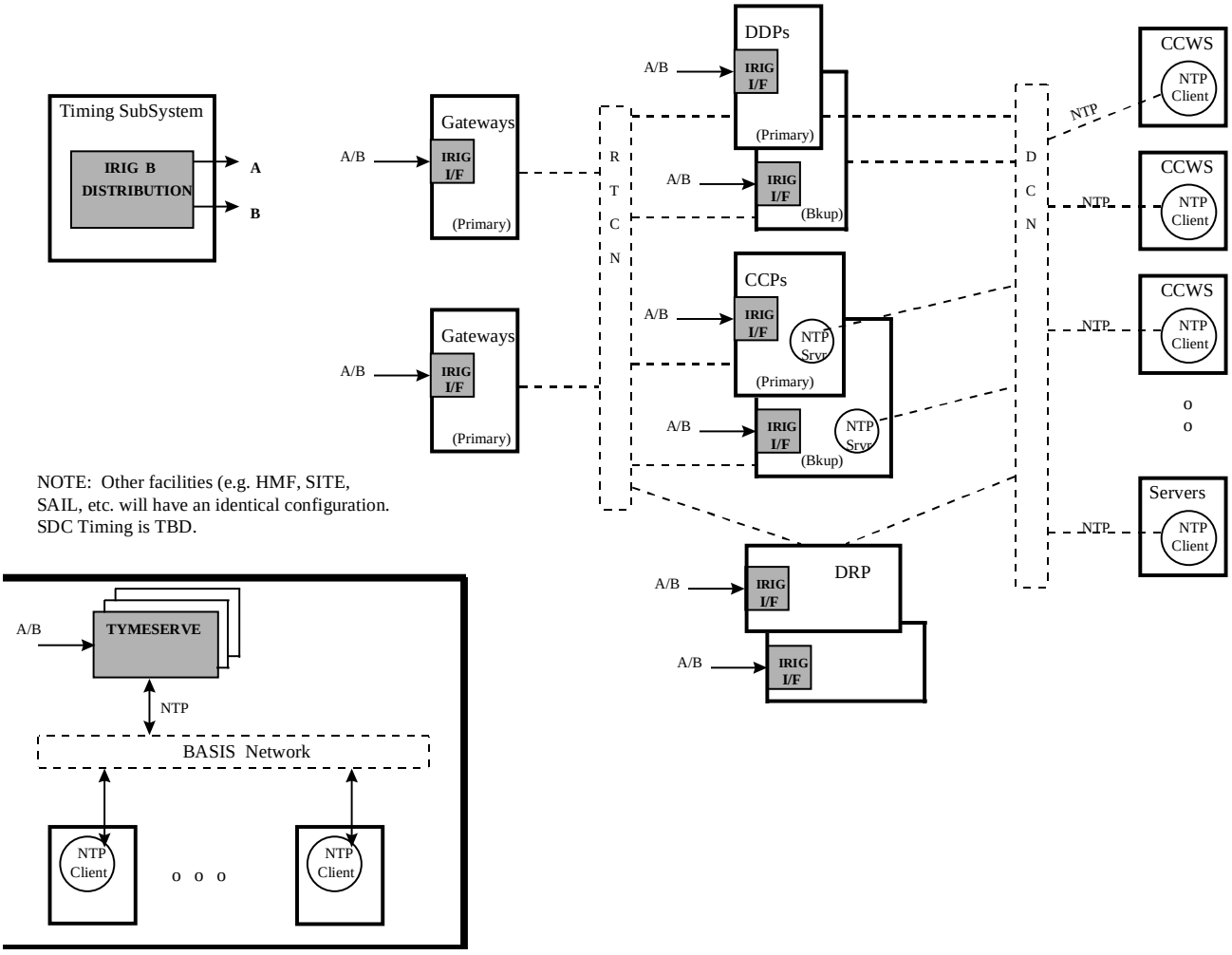
MILA Format: The Timer Services will also format the CDT as required by the Wall Clocks. Currently, the KSC Launch Status Clock System requires this data in MILA Format for displaying the CDT negative sign. In Atlas, the software design and implementation will be dependent on the hardware identified which will provide the MILA Format. It could very well be that this function may not be performed at the CCP due to the other Wall Clock Display requirements for Hold/Count and the Active Periods. It is assumed, at this point, that for Atlas the interfacing approach to the Wall Clocks will be an interim solution (i.e. Portable MILA Format Reader, patch to the existing Wall Clocks, etc.).

Support of the Wall Clocks for Hold/Count, Camera Start Sequence and other Active Period commands (Window Remaining, APU Run Time, etc.) are post Atlas. A proof of concept will provided in Atlas for the display of CDT to an Alpha Numeric Wall Clock Display.



CDT OPERATIONAL CONCEPTS DIAGRAM

Universal Coordinated Time (UTC). Currently, the UTC is distributed by the Launch Status Clock System throughout the KSC facilities. Since the timing function is critical to operations, reliable redundant IRIG B interfaces (A & B) are provided by this system.
The timing assessment for the RTPS is based on a single IRIG B interface card with a single input port at each Gateway, DDP, CCP, and DRP. However, a Reliability Analysis will be conducted to determine the final design and implementation. The analysis will take into account single points of failure and the duration as to how long the system can retain the required accuracy utilizing the platform local time. Hardware maintenance and hardware and software upgrades of timing elements in one control group should not impact operations of another group if a physical control group separation has been configured.
Also, ever since JUNO, the RTPS has been utilizing a COTS TYMSERVER Unit that inputs IRIG B and provides the UTC to all the platforms using the Network Timing Protocol (NTP) via the Utility/RON. Since the CCP requires an IRIG Interface Card for the Count Down Time, it can also provide the NTP to the RTPS CCWSs. The configuration setup for NTP Servers and their designated NTP Clients will be done during the OS download. The separation of NTP to the CCWS will be a logical separation.
The BASIS network will contain its own NTP TYMSERVER Units in which clients can obtain the GMT. The SDC currently uses the KSC Global Time Server and NTP for acquiring time. Requirements for changing this configuration is TBD.



1.4 SYSTEM TIMING THREAD SPECIFICATION

1.4.1 Statement of Work

Analyze the SLS and "Other Requirements" that are included and provide an assessment in DP1 of:

- Whether the requirement is incorporated into the Atlas release,
- The level of maturity the requirement will achieve in Atlas
    - Low = function only implemented in one subsystem,
    - Medium = function implemented in multiple CSCIs/Subsystems, but capability not available across the entire system,
    - High = function is implemented nearly everywhere, or
    - Complete = function is implemented everywhere that it is needed
- If the requirement will have to be verified for HMF to be declared operational
- Provide for input of UTC into the RTPS system
- Provide for output of CDT and MET to other external users in MILA format
- Provide **design** and **implement a proof of concept** for output of CDT, MET and GMT to drive displays
- Provide design for management of time remaining clocks.
- Provide the **initial** capability to synchronize Greenwich Mean Time (GMT) on board the Orbiter's Master Timing Unit (MTU) to Universal Time Coordinated (UTC) with an accuracy of less than or equal to one millisecond
- Provide the capability to switch to local time both for the test set and on a subsystem basis.
- Resolve time tagging design for
    - GSE Gateway
    - PCM Down Link
    - Other Gateways
    - Command and Control Processor
- *Provide services to allow references when using time to convert to: [Titan]*
    - *CDT*
    - *TREF*
    - *Time from Present*
    - *Orbiter GPC Time*
- Investigate need for simulation time and use of subsystem time
- **Conduct a System Timing Reliability, Maintainability, & Availability (RMA) Engineering Analysis for support in selecting a distribution implementation approach of UTC.**
- **Evaluate the current timing system and Engineer a solution for interfacing to the existing or new Wall Clocks, Remaining Clocks and Alpha Numeric Displays.**
- **Evaluate the current timing system and Engineer a solution for interfacing to the High Speed Camera Sequencer for initiating a start sequence command.**

1.4.2 Requirements

This section contains a list of SLS and high level derived requirements that are driving the design of the capability.

SLS Requirements:

- The CLCS shall be capable of accepting and processing a continuous IRIG-B123 signal as defined in:
    - KSC-GP-792, Section 2.8, Timing Signal Formats [Partial]
    - IRIG-200-95, sections applicable to IRIG-B123, Inter-Range Timing Formats [Partial]
- The RTPS shall be capable of outputting CDT/MET at a 1 second rate to the facility timing interface in the format described in:
    - 80K56049, MILA Countdown Time Code Format [Partial]
- The RTPS shall be capable of outputting CDT/MET at a 1/10th second rate (10 times per second) to the facility timing interface in the format described in:
    - IRIG 215-96, IRIG Countdown Time Code Format [Partial]
- The RTPS shall provide the capability to set, start, stop, hold, and resume facility (ground) CDT/MET from selected operator positions. [Partial]
- The RTPS shall provide the capability to set, reset, start, stop, and hold the “time remaining” clocks in the OCR/MFR. [None]
- The RTPS shall provide the capability to synchronize Greenwich Mean Time (GMT) on board the Orbiter’s Master Timing Unit (MTU) to Universal Time Coordinated (UTC) with an accuracy of less than or equal to one millisecond. [Partial]
- All subsystems acquiring data from external GSE shall be synchronized to the Facility Timing UTC Interface to within 10 microseconds to support 100 microsecond measurement time-stamping. [Partial]
- All subsystems (except workstations and GSE Link Gateways) shall be synchronized to Range Time within TBD microseconds to support 1 millisecond time-stamping of measurements. [Partial]

Other System Requirements

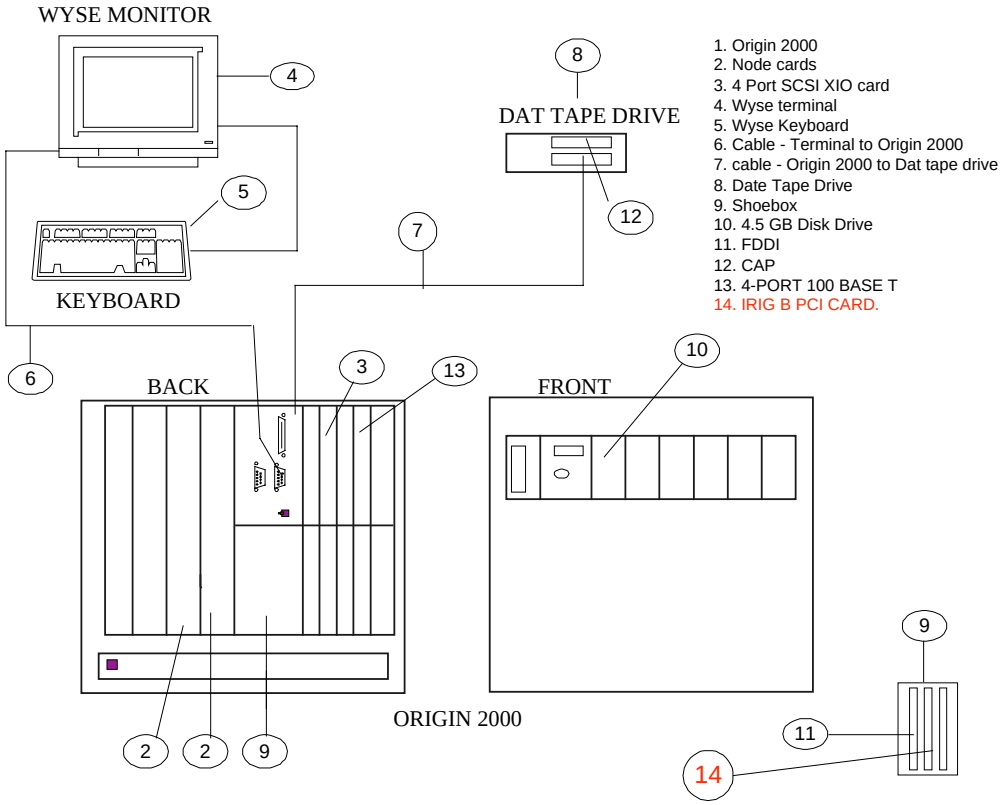
- 4.5.2.2 The system shall provide a method to specify and cancel event notification and an event handler for the arrival of a specific GMT. [Partial]
- 4.5.2.3 The system shall provide a method to specify and cancel event notification and an event handler for the arrival of a specific CDT or MET. [Partial]
- 4.5.2.10 The system shall provide a method to activate or inhibit all timer event notifications active for the application. [Low]
- 4.7.2.2 The system shall provide a method to set the systems CDT/MET. [Partial]
- 4.7.2.3 The system shall provide a method to determine if the GMT, CDT, or MET is using internal simulation of an external data source. [Partial] [Review]
- 4.7.2.5 The system shall provide a method for reading the system CDT/MET. [Partial]
- 4.7.2.6 The system shall provide a method to start and stop the system CDT/MET. [Partial]
- 4.7.2.7 The system shall provide a method to hold the system CDT/MET. [Partial]
- 4.7.2.1 The system shall provide a method to set the system GMT. [Partial]

- 4.7.2.4 The system shall provide a method for reading the systems GMT. [Partial]

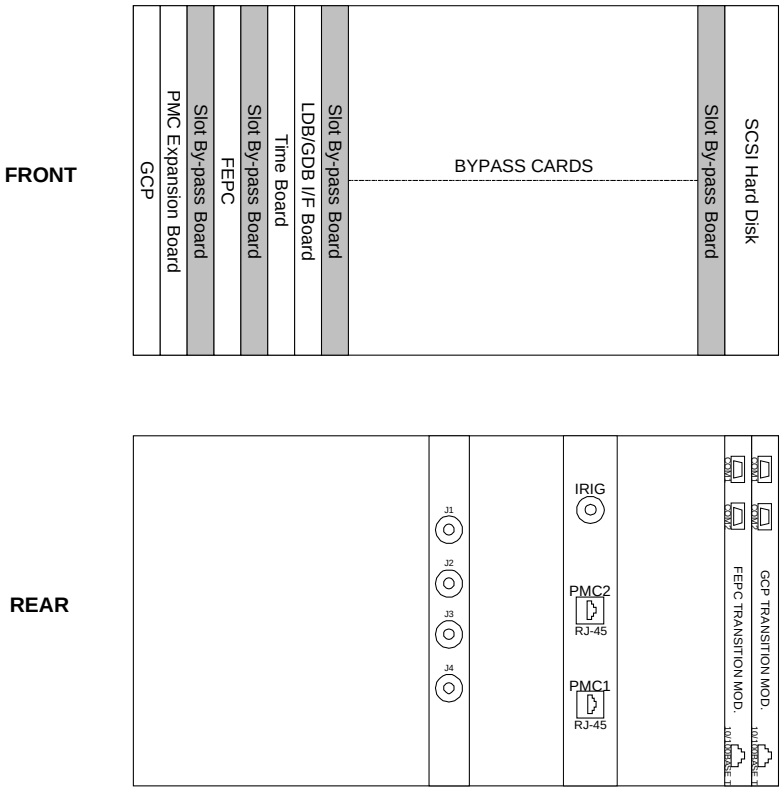
1.5 SYSTEM TIMING THREAD HARDWARE DIAGRAM

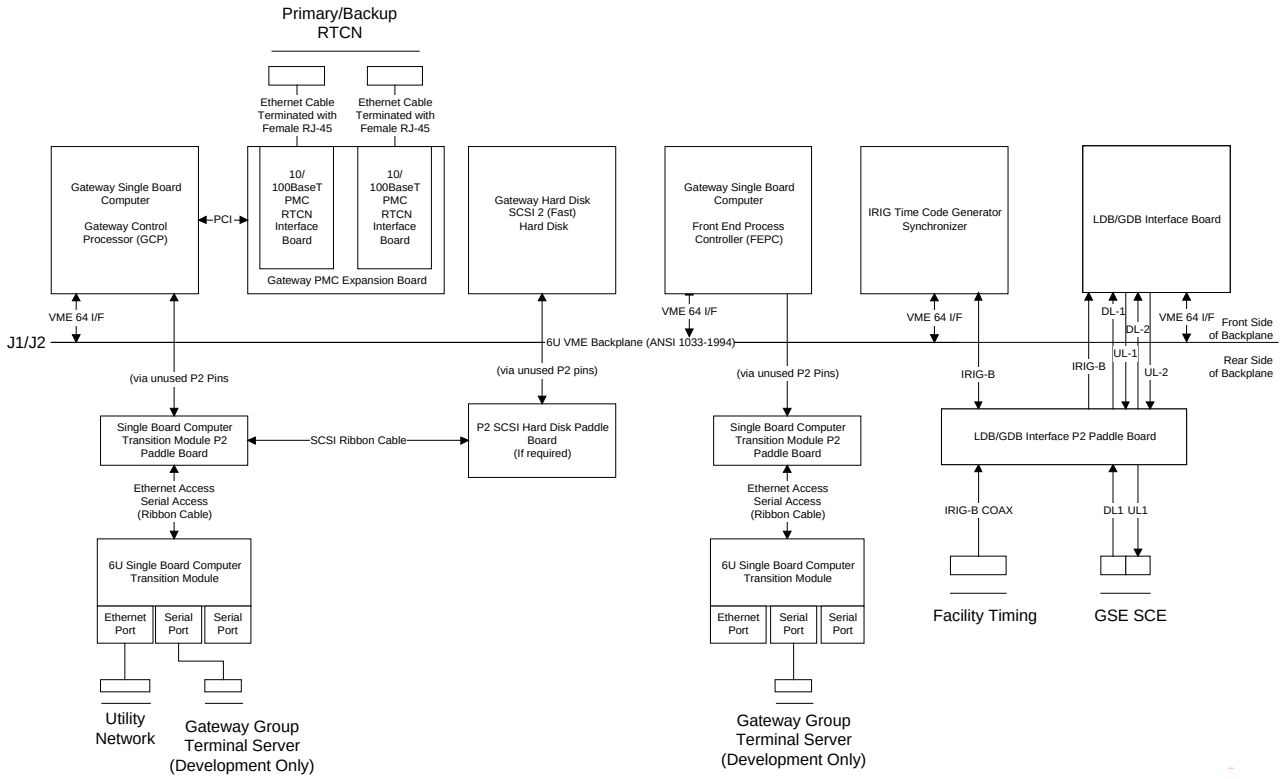
Below are two hardware diagrams which indicate the IRIG Timing Board installations; one proposed implementation for the Origin 2000 and the other is the current implementation on the Gateways. The final implementation for the DDPs and CCPs is driven by the procurement of the new platforms. The IRIG Timing Board for the DRP is TBD and will be addressed in the DRP Thread.

IRIG BOARD IMPLEMENTATION - BASED ON AN ORIGIN 2000



GSE Gateway VTP





1.6 SYSTEM TIMING THREAD DELIVERABLES

Provide a list of deliverable products for this capability (e.g., CSCI Object files)

Software:

Deliverable	R&D Document	Code	API Manual	Users Guide
CSC Data Distribution	Update	x	Update	
CSC Timer Services	Update	x		Update

Hardware Example:

Deliverable	R&D Document	Drawings	Prototype	API
Timing Subsystem	x	x		x

Interface Description Document:

IDD Names	Responsible CI	Supporting CI
Timing Subsystem Time Interfaces	Timing Subsystem	

Other:

COTS Evaluation Trade Study on Time Products
Engineering RMA Analysis

1.7 SYSTEM TIMING THREAD ASSESSMENT SUMMARY

This section contains the summary of the costs and labor involved in implementing the capability. It is broken into three sections. The first is a summary of the individual CI (CSCI and HWCI) labor assessments. The second is a summary of hardware costs. The third is a summary of procurement activities needed.

1.7.1 Labor Assessments

The total Labor Costs required to provide this capability is summarized in the following table;

No.	CSCI/HWCI Name	Atlas LM	Changes covered in
1	System Engineering	5	
2	PCM Downlink	1	
3	LDB/Uplink	0	LDB Thread
4	System Services	20	
5	Data Distribution	3	
6	Command Support	0	Commanding & Command Process Thread
7	Application Services	0	CCP Application Integration Thread
8	Timing Subsystem HWCI	8	
	TOTAL	37 LM	

1.7.2 Hardware Costs

The total Hardware Costs required to provide this capability **for Atlas only** are summarized in the following table:

Item number	Name	Unit Cost	Qty.	Total	Assumptions
1	PCI-SG	$1,300	10	$13,000	New Buy
2	800 Series Time Code Unit	$2,800	3	$8,400	New Buy
3	Cables and connector	N/A	1000 ft	$2000	
4	Test Equipment	TBD		TBD	
5	Alpha Numeric Display	$8,000	1	$8,000	New Buy
		Total:		**$31,400**	

1.7.3 SYSTEM TIMING THREAD Procurement

The Timing Subsystem Hardware will be procured for Atlas. A summary of the procurement schedule is shown below:

Procurement Activity	Completion Date
Define Timing H/W Requirements	03/13/98
Submit Purchase Request to Procurement	04/22/98
Award Contract	04/23/98
Receive H/W Material @ KSC Dock	06/12/98

1.8 SYSTEM TIMING THREAD SCHEDULE & DEPENDENCIES

1.8.1 Schedule

This section contains a schedule of major activities and milestones.

Atlas Milestones:

Task Name	Start	Finish
Atlas Assessment Kickoff	01/19/98	01/19/98
Concept Panel Internal Review	02/18/98	02/18/98
Concept Panel	02/20/98	02/20/98
Atlas Development		
CSCIs Requirement Panel Internal Review	03/31/98	03/31/98
CSCIs Requirement Panel	04/02/98	04/02/98
CSCIs Design Panel Internal Review	04/28/98	04/28/98
CSCIs Design Panel	04/30/98	04/30/98
Timing Subsystem Requirement Panel Internal Review	03/10/98	03/10/98
Timing Subsystem Requirement Panel	03/12/98	03/12/98
Timing Subsystem Design Panel Internal Review	04/07/98	04/07/98
Timing Subsystem Design Panel	04/09/98	04/09/98
Submit Purchase Request to Procurement	04/22/98	04/22/98
Award Contract	04/23/98	04/23/98
Receive H/W Material @ KSC Dock	06/12/98	06/12/98

Task Name	Start	Finish
Timing Subsystem HIT	06/22/98	06/22/98
CSCI Unit Test	TBD	TBD
CSCI Integration Test	08/03/98	08/14/98
Support other CSCIs, System Integration & Test	08//14/98	09/25/98
Atlas System Integration & Test	08/21/98	09/25/98
System Integration & Test Complete	09/25/98	09/25/98

1.8.2 Dependencies

This section lists dependencies that the thread has in order to be satisfactorily specified, designed, implemented, or tested.

No.	Dependency Area	Dependency	Need Date
1	Timer Services	IRIG I/F Card API Definition	04/15/98
2	Data Distribution	IRIG I/F Card in CCP/DDP SDE - JSC	05/30/98
3	Data Distribution	IRIG I/F Card API Man pages for coding	05/11/98
4	Data Distribution	IRIG I/F Card API for code testing	06/01/98
5	Timing Subsystem	Reliability Analysis Complete	03/23/98
6	GMT Correlation	Test Displays for Time Correlation Commands	TBD
7	GMT Correlation	Test Displays to set MTU GMT Delta	TBD
8	GMT Correlation	PCM Steam Generator w/embedded time	TBD
9	GMT Correlation	KATS Lab	TBD

1.9 SYSTEM TIMING THREAD SIMULATION REQUIREMENTS

The System Timing Thread will require the following for as Test Tools and Simulators:

- Test Data Generator – Generate PCM Stream with embedded GMT
- KATS Lab that can respond to LDB/Uplink timing commands
- IRIG B and MILA Display Readers
- Test displays for the MTU Time Correlation user entries

1.10 SYSTEM TIMING THREAD INTEGRATION AND SYSTEM TEST PLAN

This section contains the initial plan for CSCI Integration Test (i.e., CIT) and System Level Testing. This plan describes how the capability will be tested both during the CIT and System Test phases.

CIT Test

TCID Required: Validation TCID which contains the Timing FDs. (Need the OI PCM stream and GPC FDs.

System Resources Required: IDE with PCM & LDB Gateways; IRIG I/F Card in the CCP, DDP, & DRP; CCWS; KATS Lab

CSCI/CSCs required: Timer Services, Network Services, Data Distribution, Application Services, Command Management, EIM, PCM & LDB Gateways, & Timing Subsystem HWCI.

Additional Data Requirements:
1. An IRIG B input source will be required at the Gateways, DDPs, & CCPs.
2. PCM data stream with embedded time.

Test tools: Test tools required for Atlas are: IRIG and MILA Readers, LANalyzers for verifying rates on the Network & a simulator that can verify commands sent by the LDB Gateway.

Test plan: Following is an overview of the test plan.

UTC Distribution Function:
1. The Timing Subsystem will verify the distribution of IRIG source to each platform using an IRIG Reader.
2. The Timing Subsystem will verify the IRIG B Interface Card functionality and the availability of the API.
3. The Network Services will verify the local platform system time and its distribution by NTP to the CCWSs.
4. The Network Services will verify the NTP implementations for all facilities.

Count Down Time:
1. The Timer Services will verify the time commands.
2. The Timer Services will verify synchronization of the CDT to IRIG.
3. Data Distribution will verify the distribution of the CDT/MET to the CCWS and CCP.
4. Data Distribution will verify the time distribution is a separate stream and not associated with the Gateway input data rates.
5. The Timer Services will verify that the CDT is being output at the IRIG B and MILA formats by using IRIG & MILA Time Code Readers.

Time Correlation:
1. The PCM Gateway will verify the Time Commands received via Command Management.
2. The PCM Gateway, using a TBD PCM stream generator, will verify the extraction of the embedded time.
3. PCM Gateway will verify that the initial calculated time delta is with the required accuracy requirements (Note: The final delta based on path will not be tested during Atlas).
4. User Test Displays will verify the command responses from the PCM Gateway; which include the MTU GMT time delta.
5. The LDB Gateway will verify the Time Commands received via Command Management
6. The LDB Gateway, using a TBD Orbiter MTU simulator, will verify the initial and delta GMT commands to the Orbiter.
7. User Test Displays will verify the command responses from the LDB Gateway.

System Test

TCID Required: TCID will contain the Timing FDs.

System Resources Required: IDE with PCM & LDB Gateways and KATS Lab; IRIG I/F Card in the CCP, DDP, DRP & CCWS. Also require same CCP, DDP, DRP & CCWS configurations for the HMF and SAIL facilities.

CSCI/CSCs required: Timer Services, Network Services, Data Distribution, Application Services, Command Management, EIM, PCM & LDB Gateways, & Timing Subsystem HWCI.

Additional Data Requirements:
1. An IRIG B input source will be required at the Gateways, DDPs, & CCPs.
2. PCM data stream with embedded time.

Test tools: Test tools required for Atlas are: IRIG and MILA Readers, LANalyzers for verifying rates on the Network & a simulator that can verify commands sent by the LDB Gateway.

Test plan: Following is an overview of the test plan for System Test.

UTC Distribution Function:
1. Verify the distribution of IRIG and its format at each platform.
2. Verify the UTC time performance requirements.

Count Down Time:
1. Verify synchronization of the CDT to IRIG.
2. Verify the distribution of the CDT/MET to the CCWS and CCP.
3. Verify that the CDT is being output at the IRIG B and MILA formats by using IRIG & MILA Time Code Readers.
4. Verify the CDT performance requirements.

Time Correlation:
1. Verify the performance requirement for determining the MTU time difference to the GMT.
2. Verify the MTU time delta is correctly calculated and distributed to the final destinations.
3. Verify the initial and delta GMT are sent from the LDB Gateway to the MTU simulator.

1.11 SYSTEM TIMING THREAD TRAINING REQUIREMENTS

This section contains a list of Required Training. The list should consider developers, sustaining personnel and operations personnel.

1.11.1 Training Needed

Training for approximately 3 Engineers on Timing Formats, Protocols (IRIG, MILA, NTP, etx.) and Timing Synchronization Methods and Design Concepts.

1.11.2 Training to be provided

Training is TBD and is expected to be provided post Atlas.

1.12 SYSTEM TIMING THREAD FACILITIES REQUIREMENTS

The facility requirements for the layout and installation of Wall Clocks and displays are post Atlas.

1.13 TRAVEL REQUIREMENTS

Travel is expected for: 1) evaluation and review of COTS timing products and their implementation in commercial and other facilities with Similarr requirements. 2) Training Classes

Example:

From	To	Reason	No. People	Duration	Est. Date or Frequency
KSC	TBD	Evaluate/Review COTS Timing Products	2	TBD	3
KSC	TBD	Evaluate other similar sites	2	TBD	2
KSC	TBD	Timing Formats, etc. Training Classes	3	TBD	2

1.14 SYSTEM TIMING THREAD ACTION ITEMS/RESOLUTION

- The CCP and/or the DDP may not be the appropriate place for the MILA time code distribution and for setting the remaining clocks. Both of these functions require special interface signals which may not be available or properly handled by the CCP and/or DDP.

2. CSCI ASSESSMENT

2.1 PCM DOWNLINK CSCI ASSESSMENT

PCM Decommutation CSC Work Required

. The OFI PCM Downlink Gateway shall accept and process GMT Correlation requests.
. The OFI PCM Downlink Gateway shall provide the capability to extract the Orbiter embedded time from the OI PCM stream.
. The OFI PCM Downlink Gateway shall provide the capability to calculate the time different between the extracted Orbiter time and IRIG B in microseconds.
. The OFI PCM Downlink Gateway shall not suspend PCM stream processing of the OI area during a GMT Correlation request for more than 1.3 seconds.
. The OFI PCM Downlink Gateway shall not suspend PCM stream processing of the GPC area during a GMT Correlation request for more than 3.3 seconds.

CSCI Assessment

CSC Name	CSC Labor (LM)	% of CSC
PCM Decommutation	01	20

Basis of estimate

It is estimated to be approximately 200 lines of code to provide GMT Correlation function.

Documentation

Document Type	New/Update	Number of Pages
Requirements and Design Documentation	Update	5
Users Guide	Update	3
API Interface Document		0
Interface Design Document		0
Test Procedure	Update	5

Assumptions

This is an added on function to the existing PCM Decommutation CSC.
The delta time will be calculated in microseconds.

Open Issues

None

COTS Product Dependency List

None

2.2 LDB/UPLINK CSCI ASSESSMENT

LDB/UPLINK CSC Work Required

. The LDB/UPLINK Gateway shall process and send Orbiter MTU the Initial GMT Command.
. The LDB/UPLINK Gateway shall process and send the Orbiter MTU the GMT Delta Command.

CSCI Assessment

CSC Name	CSC Labor (LM)	% of CSC
LDB/UPLINK CSC	0	90%

Basis of estimate

The DEU equivalent functionality is an effort that was completed for Thor.

Documentation

Document Type	New/Update	Number of Pages
Requirements and Design Documentation	Update	5
Users Guide	Update	3
API Interface Document		0
Interface Design Document		0
Test Procedure	Update	5

Assumptions

This is an added on function to the existing LDB/UPLINK CSC.

Open Issues

None

COTS Product Dependency List

None

2.3 SYSTEM SERVICES CSCI ASSESSMENT

The System Services CSCI will provide updates to support the distribution of CDT to the timing subsystem. It will also make use of an IRIG timing board added to the CCP for CDT synchronization.

Timer Services Work Required

Timer Services will perform the following work in support of this thread:

- Design and implement the interface from the central timer server to the timing subsystem for the external distribution and display of CDT/MET.
- Synchronize the publishing of CDT/MET to a UTC interrupt provided by an IRIG timing board in the CCP.
- Support architecture definition of the timing subsystem interface for the display and control of time remaining clocks (implementation is post-Atlas).
- Write a driver to interface to the IRIG card to set the local time and allow applications to get hardware interrupts
- Provide a proof of concept to drive a alphanumeric wall clock display.

Network Services Work Required

Network Services will perform the following work in support of this thread:

- Modify the NTP configuration to use CCP platforms (which now have IRIG timing boards) as the time server for a set.
- Work the issue of handling control groups that can be connected to any flow zone (i.e. OCR).

CSCI Assessment

CSC Name	CSC Labor (LM)	% of CSC
Timer Services	20	60%
Network Services	0.5	90%

Basis of estimate

This estimate is based on the projection that another 2300 SLOC will be produced to implement these capabilities. The effort to define the architecture and interface for the time remaining clocks will be 6 LM.

Documentation

Document Type	New/Update	Number of Pages
Timer Services		
Requirements and Design Documentation	Update	8
Users Guide	Update	10
API Interface Document	No Change	-
Interface Design Document	New	20
Test Procedure	Update	20
Network Services		
Requirements and Design Documentation	Update	2
Test Procedure	Update	5

Assumptions

- Timer Services will produce a CDT in MILA time format via a device driver interface on the master CCP.

Open Issues

- The device driver interface for generating CDT in MILA time format is not well defined..

COTS Product Dependency List

Product Name	Quantity Needed	Need Date
IRIG-B Board Driver	1 per CCP	4/15/98

2.4 DATA DISTRIBUTION CSCI ASSESSMENT

The Data Distribution CSCI will provide updates to support the distribution of CD/MET. It will also make use of an IRIG timing board for CDT synchronization.

Data Distribution Work Required

Data Distribution will perform the following work in support of this thread:

- Create new API allowing Timer Services to publish CDT/MET
- Modify ddp_server to handle time packets
- Re-use ddp_sender to buffer time packets and send to DCN at DSR
- Re-use ddp_receiver to read time packets on DCN
- Sync CDT/MET to IRIG B (via API call provided by T S/S) when Gateway is not active.

CSCI Assessment

CSC Name	CSC Labor (LM)	% of CSC
Data Distribution	3.0	70%

Basis of estimate

This estimate is based on the projection that another 1650 SLOC will be produced to implement these capabilities.

Documentation

Document Type	New/Update	Number of Pages
Data Distribution		
Requirements and Design Documentation	Update	8
Users Guide	Update	10
API Interface Document	No Change	-
Interface Design Document	New	20
Test Procedure	Update	20

Assumptions

None.

Open Issues

None.

COTS Product Dependency List

- IRIG cards on CCP & DDP at Houston for testing (need date: 5/30/98)
- IRIG Card APIs to Sync CDT/MET to IRIG B
  - Man pages for coding (need date: 5/11/98)
  - API stubs for testing (need date: 6/1/98)
  - Working code for testing (need date: 7/6/98)

2.5 COMMAND SUPPORT ASSESSMENT

Command Support will add/modify objects to the Command Interface to Command Management to issue C-to-Cs to LDB and PCM Gateways

Command Interface Work Required

Support the PCM Start GMT Correlation Command.
Support the DEU Uplink Command for sending the initial and delta GMT value to the Orbiter.

CSCI Assessment

The labor costs for the additional Command Support will be addressed in the Commanding and Command Processor Thread Phase 3 Assessment for LDB.

2.6 APPLICATION SERVICES/EIM SERVICES CSC

EIM Services is to provide a test EIM which performs the appropriate actions to set the on-board clocks.

Applications Services - Tailored Services CSCI Assessment

Since EIM Services already has to develop test EIMs to test the PCM and LDB gateways, this is considered part of the work already covered in the CCP Application Integration Thread.

CSC Name	CSC Labor (LM)	% of CSC
EIM Services	0	90

Basis of estimate

Not applicable.

Documentation

Document Type	New/Update	Number of Pages
Requirements and Design Documentation	New	10
Test Procedure	New	4

Assumptions

None.

3.0 TIMING SUBSYSTEM HWCI ASSESSMENTS

This section is provided for the individual HWCI leads to fill in and provide the details of their assessments. The thread lead should use this information to provide the summaries in section 1. The details are not presented in any of the panels unless needed by the presenter as backup.

3.1 TIMING SUBSYSTEM HWCI ASSESSMENTS

This assessment provides schedule, cost, and impacts for the demonstration of IRIG B distribution , display of countdown time using the MILA time format and NTP timing for the BASIS Network. The LCC timing system within 2R22 will provide an IRIG B signal for use by the CCP and DDP devices. The CCP will provide a countdown time in IRIG B that the translator will convert and output as MILA Format Time.
TymeServers will provide the BASIS Network with time using NTP. The hardware and material cost are based on SGI's Origin 2000 and TrueTime's IRIG card and generator.

Assumptions

- A IRIG card for the DRP will be included in the DRP platform cost and are not in this assessment.
- Rack space is available.
- Funding is available.
- For Atlas, the following facilities will be furnished with IRIG card:
  HMF = 2 CCP 2 DDP
  SDE HOUSTON = 2CCP 2 DDP
  SDE= 2CCP 2DDP
  IDE = 2CCP 2DDP
  LCC-X = 1 CCP 1 DDP
  Sail = 1 CCP 1 DDP
- The CCP and the DDP will have a PCI slot dedicated for the IRIG card.
- There will be a single card per platform.
- The hardware for the additional capabilities (Active periods, Wall Clock Displays, interfaces, etc) are post Atlas.
- SDE HOUSTON, SDE, and IDE will need to have a CCP that will output a countdown time in IRIG B format.
- The IRIG B input signal cable will be terminated with a BNC connector.

Work Required

- Engineering hardware time distribution of UTC.
- Support of Reliability Analysis.
- Provide installation and test procedures.
- Develop hardware Engineering Documentation.
- Conduct product survey and analysis.
- Identify test tools and equipment.
- Configure NTP servers and clients.
- Install TymeServers on the BASOS Network and configure NTP.
- Configuration of timing for the SDC is TBD.

Labor

HWCI Name	HWCI Labor (LM)	% of HWCI
IRIG B Distribution and MILA Countdown time	5 months	
Basis Modifications	3 months	

Equipment

Equipment Type	Quantity	Unit Cost Estimate	Total Cost
PCI-SG	20	$1,300	$ 26,000
800 Series Time Code Unit	3	$ 2,800	$ 8,400
Cables and connector	1,000 ft	$ 2,000	$ 2,000
		Total	$ 36,400

Documentation

Document Type	New/Update	Number of Pages
Requirements and Design Documentation	NEW	5
Drawings	NEW	2
Interface Design Document	NEW	5
Test Procedure	NEW	3

Open Issues

None

HW Products Dependency List

Product Name	Quantity Needed	Need Date
Origin 2000(CCP/DDP)	20	6/12/98
PCI adapter/shoebox	20	6/21/98